TOOTHBRUSH

FIELD OF THE INVENTION

The invention relates generally to the field of oral care, and in particular to toothbrushes.

BACKGROUND OF THE INVENTION

A Japanese patent document having an application number of 3-312978 discloses a toothbrush having a multiplicity of tufts of nylon bristles. In a first embodiment shown in FIGS. **1**, **2** and **3**, a plurality of cylindrical recessed sections in the head are set orthogonally to the longitudinal axial direction of a shank and are formed at equal intervals. Column-shaped rotary bodies **5** are respectively contained in the recessed sections. On the peripheral surfaces of the rotary bodies **5**, along the axial direction, projected strip sections **5***a* are formed, and they are set in a state that they are positioned at the opening sections of the recessed sections. At the opening sections of the recessed sections, contact surfaces to be positioned on both the sides are formed. At both the ends of the upper surfaces of the projected strip sections **5***a*, nylon bristles **6** are arranged to be vertically erected.

As shown in FIG. **3**, the arrangement described above allows bristles **6** to rotate during use of the brush. A problem with this brush is that two tufts of bristles are secured to each strip section **5***a* and thus must rotate in unison. As a result, an individual tuft of bristles cannot rotate independently of its "partner" tuft. The individual tuft may thus be prevented from achieving optimal penetration between two teeth during brushing because the partner tuft might contact the teeth in a different manner and interfere with rotation of the individual tuft.

FIGS. **4**, **5** and **6** disclose a second embodiment in which each tuft of bristles is secured to the head by a ball and socket type arrangement. While this embodiment allows each tuft of bristles to swivel independent of the other tufts, it does have disadvantages. If a tuft of bristles is tilted out towards the side of the head and that tuft is positioned near the interface between the side and top surfaces of the teeth, chances are increased that the bristle tips will not even be in contact with the teeth during brushing. Further, random orientation in which the tufts can end up after brushing detracts from the attractiveness of the brush.

SUMMARY OF THE INVENTION

The present invention is directed to overcoming one or more of the problems set forth above. Briefly summarized, according to one aspect of the present invention, a toothbrush includes a handle, a head extending from the handle, and a plurality of tooth cleaning elements, such as tufts of bristles, extending from the head. Each tooth cleaning element is supported for rotation about primarily only one axis. Each tooth cleaning element is rotatable independent of the other tooth cleaning element(s).

By having each tooth cleaning element supported for rotation about only one axis, the problems mentioned above for the ball and socket tuft support are avoided. That is, the chances are increased that the tooth cleaning element will remain in contact with teeth during brushing and the brush will be more attractive in appearance.

Further, as each tooth cleaning element is rotatable independent of the other tooth cleaning element(s), the problem discussed above with the first Japanese embodiment is avoided. Each tooth cleaning element can achieve optimal interdental penetration without interference from rotation by another tooth cleaning element.

These and other aspects, objects, features and advantages of the present invention will be more clearly understood and appreciated from a review of the following detailed description of the preferred embodiments and appended claims, and by reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a toothbrush according to a first embodiment of the invention;

FIG. **2** is a partial sectional view of the head of the toothbrush of FIG. **1** and one of the tooth cleaning elements;

FIG. **3** is a sectional view taken along the lines **3**—**3** of FIG. **2**;

FIG. **4** is a front view of an alternative tooth cleaning element; and

FIG. **5** is a side view of the tooth cleaning element of FIG. **4**.

FIG. **6** is a graph showing interproximal residence time of mobile tufts and fixed tufts in the interdental gap(s).

DETAILED DESCRIPTION OF THE INVENTION

Beginning with FIG. **1**, a toothbrush **8** includes a handle **10** from which extends a head **12**. Head **12** includes a first group of tooth cleaning elements **14**, such as tufts of bristles, which are secured to the head in a conventional manner (e.g. by stapling or hot-tufting). Elements **14** are designed to clean the exposed surfaces of teeth.

A second group of tooth cleaning elements **16** are secured to head **12** such that each element can independently rotate about a single axis during use of the brush. Each elements **16** can be a tuft of bristles or, alternatively, a single unitary fin made of plastic or rubber. Elements **16** are designed to penetrate in between teeth to clean the interdental spaces.

The interproximal residence time of elements **16** is significantly increased as compared to elements **14** which are rigidly fixed to head **12**. An experiment was conducted in which the interproximal residence time was determined for fixed tufts at both a 0 degree (like element **14**) and 16 degree forward angle, and for rotating tufts such as element **16**. The tufts had an average of 40 bristles each with each bristle having a 7-mil diameter. Residence times were measured on a Single Filament Tester (SFT) with a load of 4 g/tuft at velocities between 0.5 and 10 in/s.

The graph of FIG. **6** shows interproximal residence time of mobile tufts and fixed tufts in the interdental gap(s). The data are averages over 4 experiments. The error bars represent the error of the mean at the 95% confidence level. This experimental data shows that rotating tufts experience 1.6 times more interproximal residence time compared to angled fixed bristle tufts, and 2.7 times more interproximal residence time compared to vertical fixed bristle tufts. More interproximal residence time translates into better cleaning between teeth .

With reference to FIGS. **2** and **3**, the structure for enabling element **16** to rotate and its methods of manufacture will be described. Element **16** includes at its lower end a unitary bearing **18** which is cylindrical in shape and rounded at its ends. Bearing **18** can be formed by either melting some of the material from which element **16** is made, or by molding the bearing in a separate molding operation.